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CONTENTS

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Forward

WE are now entering our second year and although it is our policy to look ahead perhaps on this occasion we can make a brief comment on the past year, our first. With this long hot summer it cannot be said that the sun has not shone on " Pest Technology." However it is not only in this respect that the atmosphere has been bright. Our first year's development has been far greater than anticipated. Indeed we thought that it would take 3 years or so to reach our present stage of development. Many compliments have been passed on " Pest Technology, Pest Control and Pesticides," compliments of which we are naturally proud, but beware you cynics who say that pride comes before a fall for we too have heard the proverb. The changes that have had to be made to accommodate our rapid development have served to strengthen our opinion that no one can rest on their laurels, particularly when dealing with such a progressive and expanding industry as Pest Control.

It must be remembered that Pests are living things and as such they have had to complete in nature's battle for survival. To have survived they have had to adopt and modify themselves throughout the centuries or to put it in other words they have had to undergo evolution. Evolution can be described as a fluid state and should one pest be controlled or destroyed another will be produced to fill the corresponding niche in nature's pattern. Man is also part of nature and he too must take part in the struggle for existence.

The Pest Control Industry has its part to play and being faced with an enemy which will not give in, and which cannot be defeated outright, it will be continually beset with new problems, to which it must find the answers. However the faster the industry produces an answer the more rapid will be nature's counter attack, an example of this is the rapid development of insect resistance in those countries in which insecticides have been put to their greatest use.

To sum up, the more intensive our attacks on pests, the greater the selection pressure on them and the more rapid their evolution. The Industry must progress and " Pest Technology " must go with it.

BIOLOGICAL WARFARE

By A. K. PALMER, B.Sc., (*Pest Technology*)

PART II—Microbial Insecticides

The " microbial insecticides " form the second category of pathogenic organisms used to combat insect pests. At the present there are only one or two examples of this class, including " Thuricide " manufactured by the Bioferm Corporation and to be marketed by the Stauffer Chemical Company; " Agritrol "—Merck and Co.; " Biotrol "—Nutrilite Products Inc., Buene Park, California, plus an untrademarked product from Rohm and Haas Co., Philadelphia, Pa.

The active principle of " Thuricide " is the viable spores of *Bacillus thuringiensis* (Berliner). It has been granted temporary exemption from a tolerance by the Food and Drug Administration for application to a wide group of food and forage crops and appears promising for use on maturing fresh market crops such as cabbage or lettuce. If " Thuricide " is as successful as anticipated, other microbials will undoubtedly follow.

Hall (Agric. Chem. **14**, 1, 44) has summarised the advantages and disadvantages of microbial insecticides and it is interesting to compare these with the properties of " Thuricide."

Advantages

1. *The harmless and non-toxic nature of insect pathogens for other forms of life; hence the absence of toxic residues.*

There is no doubt that " Thuricide " possesses this property for *B. thuringiensis* (Berliner) has had a long history of absence of toxicity to warm blooded animals and plants. Further evidence of this was given in the paper " Toxicology of the Microbial Insecticide Thuricide," by R. Fisher and L. Rosner, presented to the Agricultural and Food Chemistry Division of the American Chemical Society, on 7th April, 1959. Their conclusion read: " The toxicological studies which have been described have ranged through infectivity, serial passage virulence, allergenicity, acute and chronic toxicity and subcutaneous tests in a wide variety of animals. The harmlessness of " Thuricide " and the active ingredient *B. thuringiensis* (Berliner) in these tests was firmly established by an unusual human volunteer test. The results of these tests constituted part of the evidence of safety that resulted in the award of a temporary exemption from a tolerance for the large scale application of " Thuricide " to food and forage crops."

In addition no phytotoxic effects have been observed on plants treated with *B. thuringiensis* preparations and no " off flavours " have been noted in treated food crops; " Thuricide " itself is nearly tasteless.

2. *The relatively high degree of specificity of most insect pathogens which tends to protect beneficial insects.*

B. thuringiensis (Berliner) is specific mainly to leaf eating insects and does not affect bees, insect parasites or predators.

3. *The compatability of many pathogens with many insecticides, permitting living and chemical materials to be used concurrently.*

It is stated that " Thuricide " is apparently compatible with most other insecticides, including oils. However, TEPP and polar solvents are injurious to the spores if exposure time exceeds four hours.

4. *The ease and inexpensiveness with which some pathogens can be produced.*

The manufacturers, Bioferm Corporation, Wasco, California, and the distributors, Stauffer Chemical Co., have so far issued no details of the cost but they have stated that when " Thuricide " comes on to the market, the dosages recommended are in a range that will allow it to compete with insecticides that are used for the same purposes.

5. *The pathogens may be used as sprays or dusts in the same fashion as chemical insecticides.* This naturally holds for " Thuricide."

6. *The low dosages required to kill highly susceptible insects.*

Dosage levels for " Thuricide " for economic control have been tentatively set at ½ to 3 lbs. per acre of wettable powder concentrate (3 billion spores/gram) and 5 to 30 lbs. per acre of dust formulation (300 million spores/gram). " Thuricide " should be so applied that the minimum insect injestion rate is 450 viable spores/milligram of insect body weight. Moreover " Thuricide " is stable and does not lose potency when mixed with a wide variety of diluents.

7. *The apparent slowness with which a susceptible host develops resistance to a microbial pathogen, as yet there is no authenticated instance of an insect acquiring resistance to an introduced pathogen or one directly applied in the field.*

Busvine (66th Congress of Royal Society of Health 1959, P 231 etc., P.T. **1**, 10-11) speaking on the development of resistance to chemical insecticides has stated that the more efficient the insecticide and the greater its intensity of use (i.e. the selection pressure) the faster will resistance develop. " Thuricide " which behaves in many respects like a chemical insecticide, has not been subjected to sufficiently intensive or widespread use for this to be determined, in fact, no microbial insecticide has been used extensively enough for one to determine whether they will react in a similar manner to chemical insecticides. Put into other words, the apparent lack of resistance of the hosts to microbial insecticides may not be due solely to any intrinsic property of the microbe/pest relationship, but also may be due to the fact that they have not been used on a wide enough scale.

Disadvantages

1. *There is necessity for careful and correct timing of the application of the pathogen with respect to the incubation period of the disease. As living agents micro-organisms often act more slowly than do chemical insecticides; therefore they must be applied early enough to ensure that the crop will not be damaged before the insects die.*

With " Thuricide " no greater care is required than that normally taken with chemical insecticides, for it is a quick acting disease fatal to susceptible insects. Once an insect such as the alfalfa caterpillar eats enough treated leaf to injest 40,000 to 80,000 live spores, it is overwhelmed by the disease in a matter of hours. Thus it has a quicker action than many insecticides of a chemical nature.

2. *The relatively marked specificity of most pathogens can create a disadvantage by limiting the spectrum of effectiveness of an organism to only one insect species where several pests are involved, all of which may be controlled by a single chemical insecticide.*

One of the many remarkable properties of " Thuricide " is its toxicity to a large and increasing number of pest species, particularly leaf eaters, yet it remains harmless to the pest predators and also to bees. The toxicity of " Thuricide " naturally varies with the species of insect but there remains a large number of susceptible insect pests which could be economically controlled with " Thuricide."

3. *The necessity of maintaining the pathogen in a viable condition, at high virulence and in a resistant state until the insect is contacted.*

" Thuricide " dry powder is stable indefinitely if stored at temperatures below 120°F. The residue on leaf surfaces slowly loses activity in a similar manner to most pesticides. Spores on the soil are gradually killed by sunlight or are smothered by ploughing.

4. *The difficulty of producing some pathogens either in large quantities inexpensively or both.*

It will be realised from point 4 of the advantages, that Bioferm Corporation appear to have overcome this difficulty.

5. *The tendency of some diseases to cause some portions of the insect to remain attached to the foliage of the host plant.*

Insects killed by " Thuricide " fall off the plant.

6. *The requirements of some pathogens, notably most fungi, for high atmospheric moisture in order to invade and infest their insect host. On the other hand, most bacteria, viruses and protozoa are injested, where, in the body, fluids of the host insect provide an ideal environment for development. Temperature may also be important; however, conditions favourable to the host insect generally are favourable for the development of the pathogen.*

It is thought that " Thuricide " will encounter no untoward difficulties in this respect.

Comments

Comments have been made at appropriate points in the text, however one or two facts are worth repeating.

" Thuricide " possesses an outstanding advantage in the fact that it is non-toxic to man, other warm-blooded animals and plants and the fact that it creates no residue problem. It is also specific to certain insect pests and does not affect bees, insect parasites and predators whilst remaining effective against a wide spectrum of pest species.

There remains one main problem, the answer to which cannot be obtained until " Thuricide " has been in general use for some time, that is, the resistance problem. This has already been mentioned in the preceeding text and although species of insects resistant to microbial insecticides have not yet developed there is no absolute guarantee that they will not develop with the increasing use of a microbial insecticide. If resistance does arise it will most probably be due to the development of genetic resistance amongst the insects and will not be due to the appearance of attenuated strains of *B. thuringiensis* which, as it has to be repeatedly applied, like a chemical insecticide, will not develop and spread naturally. Concurrently, in the event of the development of resistant insect strains, *B. thuringiensis* will not develop, by natural means, strains more pathogenic to its hosts. Therefore, if resistance occurs, our only answer would be to culture artificially, more virulent strains of the micro-organism.

Conclusion

Micro-organisms can play an important role in the control of insect pests, but they will have their limitations. Comparison of the two categories described, shows that these limitations will vary according to the species of micro-organism used. Some of the limitations are

already known, others will only be known after widespread use. Investigations into the use of micro-organisms for the control of insects have only just begun, only the continuation of these investigations will enable us to determine whether the distinct promise of these first attempts will be fulfilled or whether the so far hypothetical limitations will be too difficult to overcome.

These criticisms are not intended to depreciate the usefulness of microbial control methods but rather to prevent any over optimism which may follow the initial success of a microbial control programme.

ACKNOWLEDGEMENTS

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FUMIGATION AGAINST MICE*

By R. H. THOMPSON (*Infestation Control Division, Ministry of Agriculture, Fisheries and Food*).

THE need to treat foodstuffs to control mice was not a pressing problem until the war years when large stocks of food were being held. Even then comparatively little damage was caused when the stocks were held in well built warehouses in urban districts and where the quantity of goods attractive to mice — in particular food grains—in any one warehouse was not very large. In most cases baiting and trapping gave adequate control.

During the war and in the immediate post war period however very large tonnages of grain and of animal feeding stuffs were held in country stores often in temporary buildings such as aircraft hangars, Romney huts and other wartime structures. Under these conditions heavy damage was caused not only or even chiefly in the grain eaten or fouled but in the damage to sacks with consequent greatly increased labour charges for re-bagging before delivery could take place. On one occasion in 1950 out of 1,600 bags of Home grown kiln dried barley only a dozen bags were still serviceable when the grain came to be moved. In these cases baiting and trapping were inadequate and only fumigation, by reason of the penetrating properties of gases, offered any hope of successful control.

Fumigation with hydrogen cyanide

To begin with, hydrogen cyanide was used in the building as a whole. Hydrogen cyanide is extremely toxic to mice as to all mammals and small concentrations are adequate. Barcroft[1] states that one minute's exposure to a concentration of 1 mg/l is lethal to a mouse and this is confirmed by Weedon Hartzell and Setterstrom[2] who found that 50% of the animals they tested died in 1.2 mins. at a concentration of 1.2 mg/l; in 5.1 minutes at 0.3 mg/l; and in 66 minutes at 0.075 mg/l. From the last figure one might conclude that the minimum requirements for effective control of mice would be that a concentration of 0.1 mg/l should be maintained in all parts of the space to be treated for at least one hour. In a reasonably gastight empty warehouse this would not present any difficulty. Page and Lubatti[3] give figures for the distribution of hydrogen cyanide in a number of empty warehouses, in which concentrations of 4 mg/l and upwards remained 20 hours after the application of the fumigant from an initial dosage of the order of 28 mg/l. A fraction of this dosage would have been adequate for mouse control in these warehouses.

The stores in which damage was prevalent however were not gastight nor could they readily be made so. Consequently the concentrations measured were often low despite wide variations in dosage in an attempt to allow for circumstances.

Furthermore the goods were sorptive and this interfered with the distribution of the fumigant. Even in favourable conditions the concentrations of gas inside the stacks of grain were in places insufficient or at most barely sufficient to kill mice. Thus in two tests in Ministry standard warehouses* concentrations in the free space exceeded 1 mg/litre for at least 8 hours but at only three out of five points in one case and two out of six in the other did they exceed 0.1 mg/litre inside the stacks of barley. The dosage applied was 8 oz. of fumigant per 1,000 cu. ft. plus 2 oz. per ton of barley in each case.

**A Ministry Standard Warehouse is a brick building in three bays roofed with asbestos cement corrugated sheets carried on steel roof trusses. The dimensions are* 220 *ft. long* x 140 *ft. wide and between* 10 *ft. and* 12 *ft. in height to the underside of the roof trusses. The cubic content is some* 450,000 *cu. ft. and the capacity about* 3,500 *tons.*

* *This paper was originallly read to the Society of Chemical Industry in February, 1959 at a Symposium organised by the Pesticides Group.*

Despite the poor penetration of gas large numbers of mice were killed in each of these and also in similar fumigations and the treatments could be considered very worth while. Nevertheless a complete kill was unlikely except in the most favourable circumstances, consequently the method lent itself more to reducing very heavy infestations than to eliminating small infestations in the early stages before they had time to build up. And there were stores, aircraft hangars for example, insufficiently gastight or else so large in relation to the volume of the goods stored in them to make the method impracticable or uneconomic. It was to meet this situation that the use of gas proof sheets or to be more precise the technique of using several sheets rolled to one another was first developed about 1949. Since then the standard method has been to fumigate commodities under gas proof sheets with more penetrating fumigants. Hydrogen cyanide is still used in certain cases however to supplement this treatment. In Ministry Standard warehouses a dosage of 4 oz. per 1,000 cu. ft. is given to the space outside the sheets to kill mice in the building but not in the stacks at the time of fumigation. Measurements have shown the concentrations attained to be small and it is unlikely that mice hidden in deep crevices in walls would be affected but the extra cost of using

Dead mice after fumigaton of bagged grain with hydrogen cyanide. The large amount of spillage was caused by mice damaging the sacks.

cyanide is not large and has been considered a worthwhile precaution even though its efficacy is admittedly largely dependant on the weather.

Fumigation under gas proof sheets

(i) *The fumigation of grain.*

Gas proof sheets had been in use for three or four years before 1949 but only singly, though in 1946 a large stack consisting of 140 tons of wheat infested with mice had been covered with four overlapping sheets. This particular fumigation was also of interest for another reason—it was one of the few occasions on which ethylene oxide has been used against mice. The volume enclosed by the four sheets was 11,000 cu. ft. With the new technique of joining sheets by rolling the edges together it became quite usual to enclose spaces of the order of 100,000 cu. ft. using twenty or more sheets each 60 ft. by 30 ft. The fumigant used was methyl bromide which at that time was coming into general use for the fumigation of commodities. The first tests were made using a dosage of 16 oz. of methyl bromide per 1,000 cu. ft. for 24 hours. It was found that the enclosures held the gas very well and in many cases the concentrations at the end of the 24 hours were still about half that corresponding to the dosage applied. In the early stages of the fumigations there was some " layering " of the fumigant resulting in higher concentrations at the lower levels and this was reflected in the concentration time products. Thus in a fumigation of stacks of barley the c.t. products over a 24 hour period varied between 175 mg hours/litre near the top of the stack and 427 just above floor level. Calculated over a 12 hour period the corresponding figures were 62 and 278 mg hours per litre. In another test where the wind had flapped the sheets and stirred the atmosphere the range over a 12 hour period was from 80 to 160 mg hours per litre. Various figures are given in the literature for the toxicity of methyl bromide to rats and mice and from a survey of these Thompson and Turtle[4] concluded that a concentration time product of 25 mg hours per litre would be effective. The figures quoted above are all greatly in excess of this, even after only 12 hours exposure and on these and similar results in other tests a dosage of 12 oz./1,000 cu. ft. for not less than 12 hours was made the standard for the fumigation of grain stacks under gas proof sheets against mice. Experience over the years since then has confirmed its efficacy and many thousands of tons have been treated successfully.

(ii) *The fumigation of flour.*

In general no further difficulties arose in mouse control by fumigation until in 1952 the need arose to

fumigate flour. Some tests carried out in 1945 by workers from the Pest Infestation Laboratory and the Cereals Research Station had shown that it was possible to detect a foreign smell in loaves baked wholly from flour which had been treated with methyl bromide and it was considered wise to refrain from using methyl bromide on flour.

When fumigation against mice proved necessary therefore recourse was made to carbon dioxide. Work on the use of this gas against rodents had been done in the war years by workers at the Bureau of Animal Population at Oxford with particular reference to corn ricks and they showed that mice were quickly killed at concentrations of 22% and above (430 mg/l or 27 lb./1,000 cu. ft.).[5] No mouse survived this concentration longer than 1¾ hours. At 10% or below mice could survive indefinitely. At intermediate concentrations variable results were obtained and it seemed that a concentration of 15% (294 mg/l or just over 18 lb./1,000 cu. ft.) must be regarded as the minimum useful figure and that even this would need to be maintained for many hours.

To test the effectiveness of the method under the usual conditions of storage in Ministry warehouses tests were made on two similar groups of stacks each occupying about 20,000 cu. ft. when sheeted. In one group the carbon dioxide was applied in the alleyways between the stacks and in the other it was applied to the top of the stacks before the sheets were pulled over. In each case 33 blocks of solid CO_2 were used crushed into pieces not larger than a golf ball. Taking the weight of each block as 25 lb. this corresponded to about 40 lb./1,000 cu. ft.

The stacks held the gas extremely well. After six days the concentration was still as much as one third of the nominal starting concentration. The concentration inside bags of flour did not differ markedly from that in the space between bags.

Where the fumigant had been applied on top of the stacks the concentration remained above 22% for 36 hours. Where it had been applied in the alleyways between stacks the results were not so good but the figure did not fall below 15% for 24 hours and survival of mice would be unlikely.

After this successful trial the method was put into regular use. With so high a minimum concentration for effective results the sheeting and in particular the battening down of the sheets must be done with great care and the whole operation needs to be done in as short a time as possible so as to avoid loss of carbon dioxide before the fumigant is distributed under the sheets. There were a number of failures in the early days before a satisfactory code of practice was developed. With this system in operation and an increase of dosage to 50 lb. per 1,000 cu. ft. good results were consistently obtained.

The use of carbon dioxide has the disadvantage however of being costly and very laborious. When it was clear that the need to fumigate flour was likely to continue, the possibility of using methyl bromide was re-examined and some carefully controlled experiments were made by several co-operating laboratories to ascertain if a c.t. product large enough to be effective could be given without producing taint. In these experiments flour was fumigated in the laboratory at two dosages, one suitable for insect control and the other, lower, suitable for rodent control and tests were made on bread baked from this flour. No taint was found.[6] A larger-scale test was then made on a 58 ton stack of Canadian flour taking the precaution of passing the fumigant through a vaporizer before admitting it to the enclosure. Again no taint was found in bread baked from this flour and since then flour has been treated with methyl bromide when required. For rodents the dosage employed is 20 oz. per 1,000 cu. ft. for an exposure period of not less than 24 hours. It is more difficult to obtain uniform distribution of this fumigant in flour than in grain but no difficulty has been experienced in obtaining at all points tested the c.t. product of 25 mg h per litre necessary to kill mice.

The results of a typical fumigation in which a group of nine stacks was sheeted to make a single enclosure

of 24,000 cu. ft. may be quoted. Gas samples were drawn from inside bags of flour in four positions in each of two stacks. The concentration time products over 24 hours varied between 35 mg hours per litre in a top bag and 185 mg hours per litre in a bottom bag.

As an example of the saving in cost by using methyl bromide in place of carbon dioxide it may be noted that, assuming other costs to be unchanged, there would have been a saving of £108 in the fumigation of 2,230 tons of flour in a Ministry standard warehouse.

(iii) *The fumigation of corn ricks.*

The work of the Bureau of Animal Population at Oxford on the fumigation of ricks has already been mentioned. Miss E. M. O. Laurie and A. D. Middleton obtained results that were reasonably satisfactory but they doubted whether the process would be economic in view of the large quantities of fumigant required (their dosages varied between 41 and 88 lb./1,000 cu. ft.) and concluded that " the successful manipulation of the gas proof cover as a means of enclosing a corn rick completely is probably the most important result of these experiments. If a different and cheaper gas could be used in a simple way, utilizing the same method of covering, the costs of the whole operation might be halved."[7] Since that work was carried out methyl bromide has come to the fore as a fumigant and much experience has been gained in the use of gas proof sheets. It seemed worthwhile to take up again the question of fumigating ricks, which even with carbon dioxide had never gone beyond the experimental stage. Accordingly gas sampling capillaries were placed in selected ricks and arrangements were made to fumigate them shortly before threshing.

Two ricks approximately the same size one of wheat and one of barley were treated.

Covering the wheat rick with gas proof sheets proved a difficult operation because it was necessary to work from ladders to avoid damaging the thatch and there was a strong wind blowing in gusts. Two large sheets were used each 60 ft. x 36 ft. The first was placed over the centre of the rick while still folded in a narrow strip and was then pulled out to cover one half of the rick. A length of chain was placed over the top of the rick to prevent the sheet from blowing off and more chain was heaped on that part of the sheet at ground level which was catching the wind. The second sheet was placed in position in similar fashion and quickly rolled to the first one after which the chain over the latter was moved so as to weight the rolled joint.

The original plan was to seal the sheets down by placing the edges in a shallow trench dug around the rick and heaping earth on top (as was done by Laurie and Middleton in their Carbon dioxide fumigations) but because the ground was stony this could not be done. Instead the sheets were held down by chain. The task of covering the rick took four people 1½ hours. With the experience gained here the work could be done much more quickly on a future occasion.

The gas was admitted to the enclosure through copper piping running along either side of the stack

Breaking up solid carbon dioxide on the top of a stack of flour. The gas-proof sheets can be seen in the background placed ready to be pulled quickly over the stack. *Crown copyright. Photo by permission of H.M.S.O.*

just below the eaves of the thatch. Two pairs of ceramic jets were used on each side one near the middle of the branch and one at the end. Twelve pounds of fumigant was used representing a dosage of a little over 2 lb. per 1,000 cu. ft.

Gas samples were drawn from time to time during the course of the fumigation and subsequently analysed in the laboratory. Measurable concentrations remained at six out of the nine points after 22 hours. The figures were too variable to justify any attempt to measure c.t. products accurately but an estimate shows that most of them lie between 10 and 20 mg h/litre. One point was below 10 and one (in the free space) about 30 mg h/litre.

After 24 hours the sheets were still firmly in position although they had been flapping continually in the blustery wind. When they had been removed 30 mice were found round the base of the stack. Most of them were dead, but one or two were still capable of moving. They moved very sluggishly however and were obviously badly affected. With some gases animals affected to this extent might be expected to recover quickly when removed to fresh air but with methyl bromide this is not so and it is extremely unlikely that these mice could have survived. These observations are particularly interesting. The fact that among many dead mice one or two were found still alive although seriously affected by the gas indicates that the cxt products were ' on the borderline.' As the figures lay between 10 and 20 mg hours per litre (with the two exceptions noted) it would appear that 25 mg h per litre allows a reasonable margin of safety and that rather less would still be effective.

The second rick was fumigated in intense cold with temperatures below freezing point all day but there was only a light breeze and no difficulties were experienced in sheeting the rick. The same dosage of fumigant was applied as before and in the same manner. There was considerable variation in concentration from point to point but apart from a figure of 7 at one point c.t. products varied between 44 and 180—well in excess of the figure required.

After fumigation only two rats and four mice were found at the base of the stack but when the stack was threshed a hundred mice and six rats were found, all dead.

The two fumigations may be considered effective (despite the low cxt products in the first one) and it may be concluded that a dosage of 2 lb. methyl bromide per 1,000 cu. ft. in ordinary weather and 3 lb. per 1,000 cu. ft. in strong winds would be as satisfactory.

Whether fumigation would offer an economic method of ridding ricks of rats and mice it is not easy to say and further work would be desirable. Kent has given some figures for the damage caused by rats and mice and he estimated that the loss of grain from a stack of oats producing 5 tons of grain would be about 4 cwt. over an eight months period of storage and this he valued at £4 13s. 0d.[8]

The first fumigation described in this paper (on a larger rick than Kent dealt with) cost approximately £25 of which the fumigant accounted for only £4 15s.0d. the rest being labour charges and the cost of transproting the sheets. If farm workers helped with the sheeting and if there were a number of treatments in the same locality thus spreading the overhead expenses

Covering a corn rick with gas-proof sheets preparatory to fumigation with methyl bromide. From M.A.F.F. bulletin "Infestation Control"

it might be possible to conduct the fumigations at an economic price per rick. On the face of it however the method seems unlikely to achieve widespread adoption but may be of service from time to time.

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ELIMINATION OF FLUOROACETAMIDE FROM PLANT TISSUES

By Dr. M. A. PHILLIPS, F.R.I.C., M.I.Chem.E.
(*Chief Chemist, Associated Fumigators Limited*).

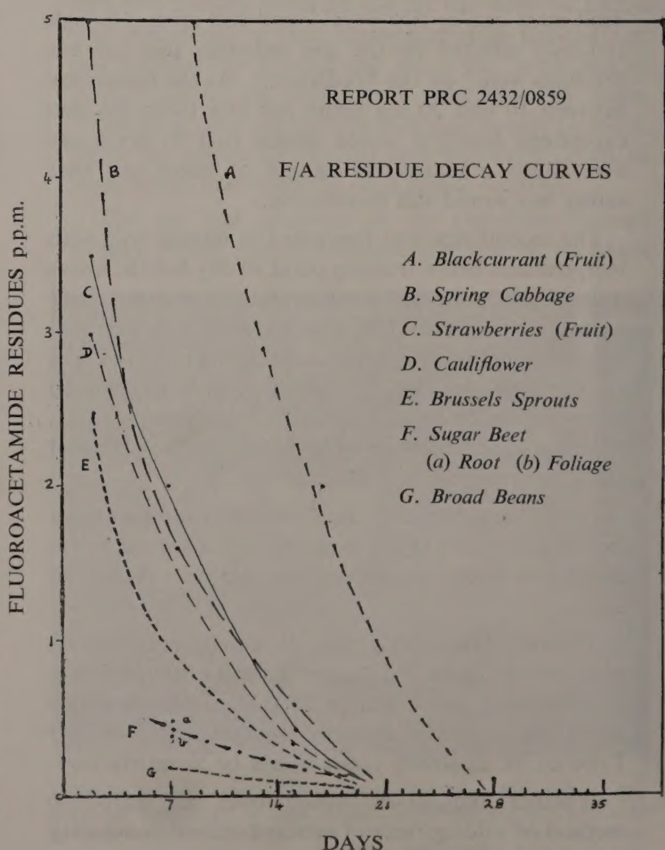
IT IS WELL-KNOWN that the South African plant, *Dichapetalum cymosum* (Gifblaar), contains fluoroacetate acid which renders it poisonous to animals twice yearly; it must be that the plant eliminates the poison reasonably quickly on each occasion although how the acid is synthesised by the plant and why, is still a mystery.

Fluoroacetamide is a systemic insecticide which is the basis of " Megatox," recommended for spraying of sugar beet, and brassica against aphid pests. This material has also proved experimentally to be successful in spraying beans against black aphids, and also against aphid pests of apples and other fruit trees and against big bud mite of blackcurrants. Clearance for use of Megatox has been obtained for use against aphids of sugar beet and against aphids of certain brassica and other clearances are anticipated.

Official clearance for such use depends upon determination of toxic residues in the appropriate plant tissues under conditions of field use, or more drastic conditions and in the course of work for clearance, we have accumulated certain data on decay rates of fluoroacetamide in a number of plant organisms. The method of analysis if these residues is due to Thompson (J.S.F.A. 1959, **10** 358-394) and we are indebted to the Ministry of Agriculture for an advance copy of this method which has enabled the work to be done. The method is tedious but accurate and is accurate to within 0.1 p.p.m. of fluoroacetamide.

The following tables and accompanying curves shew that in practically all cases, there is practical elimination of fluoroacetamide in the plant tissues examined in a period of 21 days so that harvesting 4 weeks after the last spray is safe from the consumer angle. In the case of blackcurrant, it will be seen that the residues are negligible in 28 days after the second spray and it should be noted that spraying of " Megatox " against big bud mite is done at a very high dosage level, some 15 ounces per acre as against a normal 3 ounces per acre for the other crops.

In regard to cauliflower, results to hand more recently have shewn that three sprays at weekly intervals may be given and that in this case, the period between last spray and negligible residue is still 21 days; this may be taken to indicate that in this case the rate of decay is proportional to the amount of toxic product present in the plant and this may prove to be true for most plants.



WARBLE FLY CONTROL

IN BRITAIN alone it is estimated that the Warble Fly causes losses amounting to £3,000,000 a year in hides, milk and meat and according to O.E.E.C. the losses in Europe reach the figure of £24.5 million. The Warble Fly is one of the oldest known cattle pests in this country, indeed it has been stated that fossilized grubs have been found in the Tertiary layers which were laid down some 1,500,000 years ago.

From April to September the female warble lays her eggs on the leg hairs of cattle. The egg laying in itself is so irritating that the cattle become restless and frequently stampede—a type of behaviour commonly known as " Gadding ". The reduced food intake together with the exercise consequently occuring causes the " run off " in fat cattle of a great deal of weight and in the case of lactating cows may cause a decline in milk yield of some 20-25%. Upon hatching from the eggs the small larvae or grubs burrow into the hide and migrate through the body to the gullet around which they encyst. The encysted larvae can be found around the gullet from August to February.

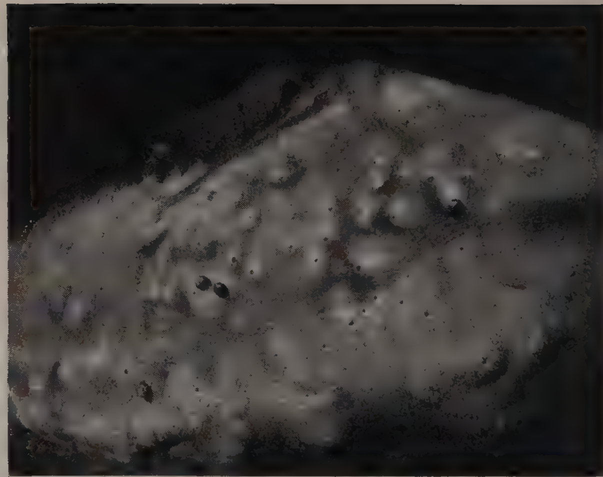
A second migration then occurs and the larvae burrow through the body until they come to lie beneath the skin of the back. Characteristic swellings or warbles are produced with an opening to the exterior through which the larvae breathe. It is these holes which make the hides unsuitable for the leather trade. These swellings are found from February to June and in the late spring of the year following their birth the grubs emerge through the warbles, fall to the ground, pupate, mate and begin the cycle all over again.

The obvious discomfort caused by the migrating larvae has the same effect as gadding in reducing milk production or causing the loss of condition and weight. For this reason a warbled beast may take several weeks longer than a warble free beast in reaching marketable condition. As the holes bored by the emerging larvae permanently damage the hide making it almost useless to the leather trade, and as butchers commonly knock anything up to £1 per head for warbled beasts, it is obvious that some form of warble fly control is required. Indeed the Warble Fly (Dressing of Cattle) Order, 1958, making it obligatory for all warble infested cattle to be dressed with derris, proves the necessity for control measures.

Up to the present time the only acceptable method of control was dressing with derris. Although the warble fly eradication campaign, conducted by the Ministry of Agriculture, Fisheries and Food in 1955-56, on the Isle of Wight, proved that derris treatment could successfully eradicate the warble fly **if** carried out thoroughly, it was realised that derris dressing could only be successful if practically every cattle owner in the country was concientious enough and had sufficient ability to carry out this thorough treatment. In the " Report on the Animal Health Services of Great Britain " 1956, the Ministry stated that: " Until a satisfactory treatment becomes available which will destroy the warbles while they are in the body of the animal the solution of the warble fly problem lies in the hands of the cattle owners." That the thorough treatment required has not been carried out on a sufficiently wide scale is shown by the fact that the warble fly still remains a pest. Moreover derris can only come into close enough contact with the grubs to be lethal, at the last stage in their migration through the body, that is, after the damage has been done. Consequently it is almost useless for a farmer to carry out derris treatment if his cattle are liable to re-infection in the following year because his neighbours have not carried out satisfactory treatment.

Many research workers devoted their attention to find a more satisfactory method of treatment—a drug which would kill the warble fly in the body of the animal. The first major break-through in the search for this cattle grub systemic occured in 1956 when scientists of Dow Chemical Company, North America, carried out the first tests with the compound 0,0- dimethyl 0, 2,4,5, trichlorophenyl phosphorothioate. This compound was originally given the name of Dow ET-57 and in North America it has been tried on some 4 million cattle with considerable success. This compound will now be marketed in Great Britain, by Dow Agrochemicals and will be sold under the trade name " Etrolene."

Etrolene which is given orally as one bolus (or pill) per 300 lbs. liveweight or the equivalent in powder as a drink or drench, has been the subject of extensive trials in this country. In the last year 650 beasts, including



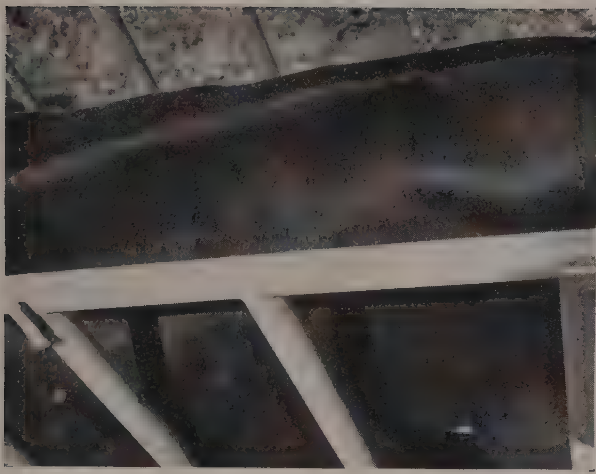
This animal has a typical warbled hide so full of warble punctures, emerging grubs, and "blind" warbles i.e., the scars left by warbles of previous years, that it will be useless to the tanner. Any animal supporting so many parasites could not fail to lose conditions and weight. *Copyright Dow Agrochemicals Ltd.*

animals from the herds of the Grassland Research Institute, Wye College, the Rowett Research Institute, the ARC's Field Station, Compton and many privately owned herds, have been used to determine the efficiency of Etrolene and the subsequently discovered compound Ruelene. All the tests have been supervised by veterinary surgeons and returns made to the Ministry's Central Veterinary Laboratory, Weybridge. The results of these trials are summarised in the following table.

Treatment	*Head of cattle*	*Total number of warbles*	*Average number of warbles per head*	*Reduction (per cent)*
Untreated control ..	155	928	5.9	0
ETROLENE bolus ..	65	92	1.4	76
ETROLENE wettable powder ..	208	202	0.96	84
RUELENE Spray 1 ..	34	32	0.9	85
RUELENE Spray 2 ..	39	52	1.3	78

Treatment with Etrolene has a number of advantages which include:—

The fact that Etrolene is given once only between 1st September and the end of November when the grubs are so small that their destruction chemically causes no side effects and occurs before they are large



The beast whose sleek, clean back is shown here comes from a Norfolk herd of pedigree Friesians given ETROLENE treatment in autumn 1958. The animal's excellent condition is plain from the state of the hide and it has suffered no loss of weight through warble damage. —Copyright Dow Agrochemicals Ltd.

enough to cause discomfort or damage. Thus the cattle owner derives benefit from treating his animals despite any neglect or inefficiency on the part of his neighbours. Contrast this with derris treatment which has to be given three times between March and May, farming's busiest season. Derris treatment is only effective after the damage has been done and a cattle owner may find his efforts wasted if re-infestation occurs through his neighbours' neglect.

The dose recommended is not critical and in fact 3 times the recommended dose can be given to cattle without any ill effects and cattle of any age can be treated.

As can be expected from its use as a cattle grub systemic the mammalian toxicity of Etrolene is extremely low, being seven times as safe as DDT and about as safe as malathion. It is decomposed by the animals to innocuous compounds within 48 hours of treatment and these compounds are rapidly excreted in the urine. However, 60 days should elapse after treatment before beef cattle are slaughtered and Etrolene should not be used on lactating cows or dry cows within 60 days of lactation. Regarding the latter point it must be remembered that cows are milked every day and treatment with derris or a similar insecticide would present very little additional work.

From the trials carried out in America and Great Britain it is estimated that Etrolene treatment has prevented live-weight losses of 50-70 lbs. per beast, couple this with the fact that the hide will not be wasted and the cost of treatment, estimated at 5-10 shillings per head, is very economical.

So far the tremendous advantages of Etrolene have more or less confined its development to the field of cattle grub control but it would be surprising if its valuable properties—particularly its low toxicity—are not utilised in other fields of pest control. This further development of the uses of Etrolene may be expected when other cattle grub systemics such as Co-Ral, Dimethoate, and Ruelene reach the marketing stage and nullify the lead that it has held. For example, Ruelene (chemical name 4-tert-butyl-2- chlorophenyl methyl methyl phosphoramidate) with which Dow Agrochemicals, and Dow International are still conducting trials, has many of the advantages of Etrolene and furthermore it is effective against intestinal worms. In addition to being administered orally in a similar manner to Etrolene, Ruelene can also be applied as a spray or can be given as an injection. In the writer's opinion and also that of several interested parties, injections provide the most efficient means of administering these drugs as it is the most accurate way of controlling the dosage given and a systemic insecticide which can be administered in this manner would be a further step forward in the control of the warble flies.

The discovery of Etrolene and its development represents a major advance in man's battle against pests.

A further method of warble fly control is by Ruelene given as a systemic spray on the back, This is quick and effective, but the spray must be applied to the beast's back at a pressure of not less than 150 lbs. per sq. inch. Copyright Dow Agrochemicals.

INTERNATIONAL AGRICULTURAL AVIATION CONFERENCE

Introduction

The 1st International Agricultural Aviation Conference, held at the College of Aeronautics, Cranfield, from the 15th to 18th September, 1959, was a tremendous affair. From the inaugural paper " A Review of the Developments in Agricultural Aviation," delivered by Sir Miles Thomas to the end of the Demonstration, the Conference was packed with solid facts and wise opinion which will promote discussion, thought and second thought for some time to come.

The wide range of information which arose places any report on the Conference between the " devil and the deep blue sea." To give a comprehensive account of the proceedings would require a complete issue of " Pest Technology," consequently it is impossible to give adequate acknowledgement to all concerned in the short space available. On the other hand we could not overlook an event of such importance to the pest control, aeronautic, farming and other industries. For the above reasons the following account is intended to be a guide to the proceedings which will be published in due course. If we can further increase the already wide interest in the proceedings we will be satisfied. However before continuing with the account we would like to comment on a question that has been raised in a number of circles. The question is, " Is agricultural aviation here to stay." People may be surprised at this indecision, pointing out that off-season outlets can be developed to give the aircraft all the year round employment and reduce costs. For instance it has been stated that British European Airways will use helicopters normally used for passenger transport for crop spraying in the season and that a Scottish firm uses its helicopters for spraying in the summer and whale spotting in the winter (Northern Hemisphere). Three further off-seasonal uses which are frequently brought up are the use of aircraft in forestry work, fertilizer spreading and particularly in hill farming where they could be of tremendous advantage for " chemical " ploughing and for seeding. The fact that extra benefits, such as lack of mechanical damage and speed of operation which cuts down labour costs, given by aerial application may outweigh its extra cost as compared with ground methods is yet another argument in favour of the continued development of agricultural aviation.

However this nagging doubt remains. Why? It is a question of economics, many of the operators are on the razor edge between bankruptcy and solvency and the reason for this is that British farmers only consider aerial application as a replacement for ground methods when an emergency occurs. Perhaps the developments have been too fast for them to obtain a clear picture, maybe they hold on to the view that " what's good enough for dad is good enough for me." Whatever the reason farmers must be shown that aerial application is not merely an emergency measure. They must be given enough confidence in aerial spraying to book in advance. Only then will the operators be given sufficient security to plan on a twelve month basis. This new approach is essential if the British Agricultural System is to be modified to allow agricultural aviation to develop to its full extent. Should this goal be reached the accruing benefits will pay for the research and changes that will have to be made. The operators have made the first move, who will make the second?

Conference

Following the Inaugural paper, **" A Review of the Developments in Agricultural Aviation,"** by Sir Miles Thomas, the Conference got off to an excellent start in the first Session with **" The Biological Basis of Aerial Agriculture "** a paper in which Mr. R. C. Amsden, Chesterford Park Research Station, used an effective, if somewhat unorthodox classification to determine the pests and diseases that could be successfully and economically treated by aerial spraying.

The paper to be discussed in the second session, **" Review of Materials Intended for Aerial Application and their Properties "** was delivered by Dr. J. K. Eaton, Woodstock Agricultural Research Station, whose own Synopsis reads as follows:—

> " The techniques for applying concentrated sprays and fertilisers are mentioned with particular reference to the factors which influence the choice between ground and aerial applicators. The various types of formulations which can be used for aerial application are reviewed and their advantages and disadvantages discussed. A survey is given in general terms of the success achieved so far by the aerial application of pesticides and fertilisers in various parts of the world. Considerable achievements have already been made, particularly in the sphere of nozzle design and it now rests largely with the chemist to define the appropriate physical properties of formulations specifically designed to meet these novel application techniques."

Dr. Eaton ended his talk with these conclusions:—

> " Considerable achievements have already been made in many parts of the world in applying pesticides and fertilisers by aircraft. Much has been done by agricultural engineers to improve nozzle design and evolve specialised aircraft for spraying and dusting purposes. However, more attention should be given to the effect of the physical properties of the formulations employed. For example, an attempt might be made to define the physical properties of the liquid carrier employed in spray liquids so as to predict more accurately the size, distribution and other properties of spray droplets emitted from a given nozzle. The aim of all this work, is to achieve maximum coverage of the target with a spray or dust

free from undesirable side effects such as crop damage or drift. This can clearly only be achieved by the closest possible co-operation between the chemist, the engineer and the biologist."

The subject of the third session was, "**The Problem of Distribution: the Physics of Falling Droplets and Particles. The Drift Hazard**" which was read by Dr. A. B. Hadaway in the absence of the author, Mr. D. Yeo, Colonial Pesticides Research Unit, who reached the following conclusions:-

"For high rates of deposition, the droplets or particles must be large, and volume median diameters must be greater than 200 microns if recoveries are to be 80 per cent or more within short distances downwind. Somewhat smaller sizes, resulting in greater numbers for a given rate of application, give more uniform and better distributions of chemical, but their use would not be recommended if the chemical might give rise to a toxic hazard at distances downwind. Aerosols and dusts, with volume median diameters of 10-40 microns, give relatively low recoveries within short distances downwind, but such small sizes are required if, for example, insects are to be dosed directly in most sites within a vegetation canopy; such small sizes do give rise, however, to the greatest drift hazards.

"The aircraft wake modifies dosage distributions, and advantage can be taken of it to increase swathe widths for low-flying aircraft. Flying very low improves the dosages obtained upon a vegetation canopy, but treatment of under surfaces is rarely satisfactory with aircraft.

"Meteorological conditions, notably wind speed and direction, modify dosage distributions near a low-flying aircraft, while wind speed and atmospheric turbulence dominate the drift hazard for a given method of application.

"In practice, variations are enormous, but there is a coherent theme to these aspects of applications from aircraft which, if understood and allowed for, will prevent any gross errors of judgement or planning."

In sequence the papers providing the basis for sessions 4, 5 and 6 were "**Aircraft. The Operators' Requirements**" by Mr. J. E. Harper, Fison-Airwork Ltd., "**Distribution Equipment Design Notes**" by Mr. R. F. Hill, Colonial Pesticides Research Unit and "**International Airworthiness Requirements for Agricultural Aircraft**" by Mr. H. G. Winton, Air Registration Board.

"**Corrosion by Agricultural Chemicals of Airframes and Spraying Euipqment**" the subject of session 7 proved to be particularly interesting and as—in the author's own words—"Published work on corrosion by agricultural chemicals is not extensive" we print here a brief account based on the author's—Mr. F. C. Porter, Aluminium Development Association—own introduction and summary.

Introduction and Summary

"The use of aircraft for distribution of agricultural chemicals has made rapid progress since its introduction 20 years ago. While superphosphate types of fertiliser have provided the main tonnage in early years, a wide variety of other fertilisers and pesticides are now distributed or are considered for aerial distribution, particularly over country of marginal fertility. Corrosion problems arise both with the spraying equipment and with the aircraft—the high cost and safety requirements associated with the latter require an accurate knowledge of corrosion effects together with preventive measures.

"The presence of water is essential to corrosion occurring by many agricultural chemicals. Dry deposits are harmless but some materials such ammonium sulphate are of a hygroscopic or deliquescent nature and may become wet even under apparently dry conditions. Water can be present from spray solutions, rain or by absorption from the atmosphere. Dissolved constituents from the chemicals or already present in the water largely determine the severity and type of corrosion, if any. Tap waters from different sources may, for example, give widely different corrosive effects, but not all dissolved constituents are harmful: some may help to inhibit corrosion. Organic solvents, in general, have no harmful effect on metals but many surface coatings or plastic materials may disintegrate under their action.

"Good design of both spraying equipment and aircraft materially reduce corrosion risks. Harmful factors include crevices and inaccessible recesses on the metal surface and the presence of dissimilar metal contacts. These can occur both directly and indirectly, e.g. from solutions of copper sulphate, copper will deposit on steel or aluminium, causing serious corrosion subsequently.

"Regular cleaning and drying of airframes and equipment markedly reduce corrosion troubles, particularly if the design avoids recesses in which water and chemical deposits may be retained. This is of particular importance with aluminium and magnesium alloys and with stainless steels: all these materials owe their corrosion resistance to a naturally formed surface oxide: deposits assist local breakdown of the oxide film.

"Published work on corrosion by agricultural chemicals is not extensive. Considerable data are given by Marshall and Nuebauer[1] on fertiliser compounds using a test (alternate dew-deposition and drying) which closely simulates practice. Schreiber[2] deals with insecticides, herbicides and fungicides equally comprehensively covering both atmospheric exposure (periodic treatment with chemicals) and continuous partial immersion. Cook and Dickinson[3] investigate insecticidal solutions with reference to the life of spraying equipment. Alquist and Wasco[4] showed that dichromate inhibits sodium trichloracetate, one of the more corrosive weed-killers, while Kelly, Falkenstein and Carr[5] tested data from sodium salt and conclude it can reasonably be used uninhibited in spray equipment. Other articles relating to spray equipment corrosion are listed.[6-10] Certain aspects of corrosion of spray equipment which show no specific features in agricultural aviation are not discussed elsewhere in the paper: these include blockage of filters and nozzles by corrosion products and corrosion-erosion effects on nozzles, gears and other moving parts. Data on the behaviour of mixed deposits or bimetallic assemblies are still required.

"Stainless steel and monel are not affected by most chemicals but their use is limited by strength/weight ratio and cost considerations. Alum-

inium alloys are widely and successfully used but pitting corrosion can occur with some chemicals, particularly in conditions of infrequent cleaning. Brass and copper are used for components especially of spray equipment and seldom corrode seriously except in ammonaical solutions but even traces of soluble copper corrosion products are sufficient to cause serious bi-metallic corrosion of other metals. Few specific data are available for mild steel or for magnesium alloys: in practice these are painted and greater interest attaches to the protective schemes. The behaviour of the agricultural chemicals with several typical schemes is discussed. Among non-metallic constructional materials fibre-glass re-inforced polyester plastic has encouraging corrosion resistance.

"The more corrosive chemicals are those which (a) produce acidity or alkalinity in solution (e.g. chlordane or sodium trichlor-acetate respectively) (b) contain heavy metal salts e.g. copper sulphate (c) contain chlorides, e.g. crude potash or (d) are hygroscopic or deliquescent e.g., ammonium sulphate."

In view of its bearing on the future of agricultural aviation on session 8, the subject of which was "**Economic Factors Affecting Agricultural Aircraft Operations**" by N. D. Norman, Crop Culture (Aerial) Ltd., probably ranks as the most important of the Conference. Our comments on the question of economics have already been passed and when the full paper is published it should be carefully studied.

Session 9, "**Safety Aspects of Aerial Spraying**" by Dr. E. F. Edson, Chesterford Park Research Station, is again a paper of extreme importance, giving an objective review of the factors involved and a logical assessment of the points of risk which must be considered for the ensurement of safety. This paper should be given as wide a readership as possible in an endeavour to allay some of the unjustified fears held by the majority of the public.

Mr. L. R. Lucassen, Flight Engineer, National Aeronautical Research Institute, Amsterdam provided the subject for session 10 with a paper on "**Flight Technique for Fixed Wing Aeroplanes in Agricultural Aviation**" his own Synopsis reads:—

"Due to the fact that agricultural flying is generally executed at very low altitude, the pilot has little time for his instruments and must rely mainly in his flying "feel." This paper discusses a number of situations that may occur in low level flight and tells the pilot how to foresee, recognize and avoid dangerous manoeuvres.

"Also a number of conditions are discussed that may be unfamiliar to light-plane pilots. Loading conditions are highly variable, requiring frequent retrimming in order to keep control forces approximately constant. The technique for take-off and landing on short fields and the influence of ambient temperature and field elevation on performance are discussed.

"The main part of the paper is devoted to the influence of wind, giving landing technique in cross-wind, possible erroneous action in turning flight from cross-wind and the effect of wind gradient on aeroplane performance and amount of aileron required in a turn.

"The information given is mostly on a qualitative basis."

The concluding session contained two papers on Ground organisation, "**The Pilot's View**" being given by Capt. Richard Bradbury, Senior Pilot, Fison-Airwork Ltd., whilst Mr. Micheal Bradford, National Association of Corn and Agricultural Merchants gave "**The Ground Operator's View.**"

Demonstration

Without detracting from the excellent performances put up by the aircraft taking part in the demonstration it can be said that many people were disappointed at the non-appearance, due to the American steel strike, of the **Piper Pawnee.** This aeroplane, designed by Piper's of Vero Beach, Florida, to be distributed in this country by Vigors Aviation Ltd., Oxford, is a low-winged monoplane incorporating a long list of design features aimed at pilot safety and maximum efficiency.

Mr. N. R. Minden, Agricultural Sales Manager, Standardised Disinfectants Company Limited, waits for Monsieur Edward le Coeur to take him for a flight in the Djinn Helicopter. Mr. Minden said afterwards "The manoeuverability and accuracy of control of the Djinn is extraordinary. It is obviously a most useful machine for applying pesticides from the air.

The Piper Pawnee. A notable absentee from the International Agricultural Aviation Conference Demonstration.

Several parties were struck with the performance of the **L-60 Brigadyr** a strong, high-winged aircraft manufactured by Omnipol, Prague. The United Kingdom Distributors are Aircraft & General Finance Corporation Ltd. The agricultural version of this plane is intended for liquid or powder application and has a hopper of 69 gallons capacity installed in the fuselage. The distribution equipment is operated by engine driven pumps and can discharge up to 660 gallons of liquid or 66 lbs. of powder per hour. A 65 ft. wide strip can be sprayed at a speed of 65-75 m.p.h. The plane also has a very low minimum speed and for out-of-season uses it can be quickly converted for use as a four-seat transport, as a freighter, or as an ambulance.

Other fixed-wing aircraft on view included a number of **Tiger Moth** variants, exhibitors being, Agricultural Aviation Ltd., Airspray (Colchester) Ltd., Crop Culture (Aerial) Ltd. The **Auster** was well represented with Auster Aircraft Ltd., showing the **Agricola** and **Workmaster** and Lincs. Aerial Spraying Co. Ltd., and Fison-Airwork Ltd., demonstrating the **Auster J.I.B.**

De Havilland Aircraft of Canada exhibited the **Beaver** which was in evidence at Farnborough earlier in the year and which is normally regarded as a highly successful " bush " aircraft. A **Prospector** formerly known as the EP.9 was demonstrated by the Lancashire Aircraft Company Ltd.

Helicopters were in evidence with Fison-Airwork Ltd., exhibiting the **Hiller U.H. 12C;** Helicop Air in conjunction with Crop Culture showing the paces of the **Djinn** and Helicopter Services Ltd., exhibiting the **Bell 47.** Here again there was a notable absentee in the form of European Helicopter's **Kolibrie.**

A number of firms with interest in crop protection had static stands at the demonstration.

Demonstrations of Pest Destruction Methods

The above demonstrations, given by the Advisory Services of the Ministry of Agriculture, Fisheries and Food, were held in conjunction with the Annual Show of the West Grinstead and District Agricultural and Ploughing Society on 24th September.

For the rabbit control demonstration a **Mini Micron** power driven machine was used to distribute cyanide gas throughout a warren. By blocking the burrows a 100% kill can be attained up to 100 yds., from the distribution point. Should the above method prove too expensive, alternative methods are spoon gassing and the use of recommended traps such as the **Juby** or **Imbra** traps.

The importance of scrub clearance as an aid to rabbit control was shown and the **Bushwakka** manufactured by Messrs. Farmfitters Ltd., proved to be an admirable machine for this purpose as it will cut grass, bracken, heather, thorn trees and similar growth. The effective use of chemicals for scrub control was also demonstrated, using 2,4-D and 2,4,5-T Esters for foliage spraying and stump treatments.

Continuing with the problems caused by harmful mammals poisoning with Strychnine was shown to be the most effective means of dealing with moles on large farms. Various mole traps were also demonstrated.

The use of wire mesh to prevent the entry of rats from entering chicken runs etc., was demonstrated but the exhibition on rodent control mainly took the form of bait placing and mixing. In conjunction with this a leaflet describing the various Wafarin mixes was distributed and attention was drawn to the poisonous nature of this rodenticide to pigs. In fact a variety of leaflets on the control of pests were to be obtained, and in an adjoining " theatre " six films, including " Rabbit Clearance," " Roof Rat " and " Grey Squirrel " were shown.

In another exhibition the Ministry drew the farmers' attention to the problems of insects in stored grain etc., and emphasised the value of cleanliness and the use of insecticides and fumigants. Regarding the latter the Ministry gave a grain fumigation demonstration in which grain or sacks were laid in the centre of a gas proof sheet and then, using a watering can preferably with a rose attached, were thoroughly and evenly soaked with fumigant which in this case was a 3:1 ethylene dichloride, carbon tetrachloride mixture. The fumigated corn should be covered with the gas proof sheet and left for approximately 48 - 72 hours. This method can be quite economic as the gas proof sheets can be hired from the Ministry for £1 per day. A leaflet describing the process was generally distributed.

NEWS

Liquid Seed Dressings for the U.K.

A major development, of particular interest to corn and seed merchants, is the recent introduction of liquid seed dressings by Shell Chemical Company Limited. This is the first time liquid seed dressings have been used commercially in the United Kingdom.

Two liquid dressings are now available: one, "Panogen," a mercury based-fungicidal dressing, has been used successfully for many years in Sweden, other European countries and America; the second, "Astex," is a new insecticidal dressing giving control of wireworm, Wheat Bulb Fly and other soil pests, which has been developed by Shell.

A new highly efficient liquid seed dressing machine is also available. It is capable of applying "Panogen" alone, which will give an effective replacement for the standard mercury dust seed dressings, or "Panogen" and "Astex" together, which will give a 'dual purpose' protection to cereals and sugar beet. With this machine it is very simple to change from single to dual purpose dressing, or from one variety of seed to another. Checking of the dressing rate is easily and quickly carried out.

The main advantages of these Shell liquid dressings over powders, are that they eliminate the danger of harmful mercury laden dust being in the atmosphere or contaminating the mill, and that they can be applied to seed with complete accuracy, without the risk of subsequent loss of dressing from the seed prior to drilling.

The costs of the two liquid dressings, per bushel of seed treated, are similar to the costs of equivalent dust dressings. The seed dressing machines are available to merchants on loan, and will be serviced by Shell.

Many seed merchants have already decided to adopt this system for this Autumn's dressing, and provision is being made for substantial supplies of the treaters and the liquid dressings to be available.

Trade Agreements for H. E. Helman and Co.

Mr. H. E. Helman, Chairman and Mr. R. C. Heath, Marketing Director of H. E. Helman & Co. (Insecticides) Ltd., who returned from America on 9th October, have concluded arrangements for the distribution of their products, "Spray-Mite," "Warble-Mite," "Firm-Foot," "Hel-Mag" and "Ly-Cene" throughout the United States of America, Canada and Mexico. Agreement has been concluded for this purpose with Haver-Lockhart Laboratories, Cutter Laboratories of Berkley and The Corn King Co. Inc., of Cedar Rapids, Iowa.

In turn, H. E. Helman & Co. (Insecticides) Ltd., have been appointed the distributors for Great Britain and Northern Ireland, of "Mamex" a mastitis prophylactic manufactured by Messrs. Biofac A/S, Copenhagen, Denmark.

Appointments in the National Agricultural Advisory Service.

Mr. O. G. Williams, B.Sc.(Agric.), formerley Assistant Agriculturaland Food Attache, Washington, has been appointed Deputy Director at the Bangor Sub-Centre in succession to Mr. H. E. Evans, B.Sc.(Agric.), whose appointment as Director of the N.A.A.S. for Wales was announced earlier this year.

Mr. A. J. Davies, B.Sc.(Agric.), Regional Grassland Officer for the East Midland Region, has been appointed Deputy Director at the Cardiff Sub-Centre in succession to Mr. J. Howard Morgan who is resigning on the 15th September, 1959.

Mr. Williams, aged 47, the son of a Conway Valley farmer, was educated at the Madryn Castle Farm School and the University College of North Wales, Bangor, where he graduated in 1941. His earlier appointments include that of Pest Control Research Assistant with the Agricultural Research Council and Chief Grassland Officer and Technical Development Officer for the Buckinghamshire A.E.C. He joined the National Agricultural Advisory Service in 1946 as Grassland Officer for the East Midland Region and became Assistant Agricultural and Food Attache in Washington in 1955 where he remained until this summer.

Mr. Davies, aged 40, the son of an Amman Valley farmer, was educated at the Pibwrlwyd Farm Institute and the University College of Wales, Aberystwyth, where he graduated. After working as Assistant Mycologist at the University College of Wales, Aberystwyth, and Superintendent of the Morfa Mawr substation of the Welsh Plant Breeding Station, he entered the National Agricultural Advisory Service as a District Officer in Cardiganshire. He was transferred to the Welsh Headquarters as Grassland Officer in 1951 and to the East Midland Region in 1957.

Dow International and Pechiney to Build Plastics Plant in France

A multimillion dollar plant for the manufacture of plastics materials will be built in France jointly by Dow Chemical International Limited S.A. and Pechiney S.A., a leading French chemical and electro-metallurgical concern.

The plant will manufacture Styron and Saran.

The facility will be operated by a newly formed French company, Plastichimie S.A., jointly owned by Pechiney and Dow. Dow's investments in the company are held by Dow Chemie A.G. in Basel, Switzerland, a subsidiary formed to finance investments overseas.

Saran is Dow's Vinylidene Chloride Copolymer. It is used as extruded fiber for outdoor furniture, awnings and seat covers, as a lining for pipes carrying corrosive liquids, and as an excellent food packaging material.

Name of Dow Insecticide changed from Korlan to Nankor

Dow Chemical International Limited S.A. has changed the name of Korlan 44E mentioned in "Pest Technology," September issue, and Korlan 25W to Nankor 44E and Nankor 25W.

Chester E. Otis, Dow International sales manager for agricultural products, said the name change was necessitated because of trademark considerations.

Nankor 44E and Nankor 25W are insect and parasite control chemicals which combine good residual properties with very low toxicity to warm-blooded animals.

The insecticide is recommended for control of such insects as external parasites of cattle, flies, cockroaches and bedbugs.

NEWS and FORTHCOMING EVENTS

Ruelene promising as a new Torsalo Control Agent

Promising results of experiments conducted with a new chemical compound for the control of "torsalo" (also known as gusano de monte, berne or nuche) in cattle were reported by Dow Chemical International Limited S.A.

The material, which is called Ruelene, is systemic in action with outstanding activity against torsalo when applied as a spray or as a drench. The chemical has already been proved effective for control of various intestinal parasites of cattle, sheep and swine.

Torsalo control tests have been run by Dow research and technical personnel on over 500 head of stock in various locations in Venezuela. These trials utilized Ruelene as a spray, injection, drench, and wetting oil. Excellent results were reported from all methods of applications, with practically a 100 per cent kill.

The larvae of the torsalo fly, scientifically referred to as *Dermatobia hominis*, has long plagued the cattle industry in Latin America. The pest affects from 30 to 50 per cent of the cattle herds and the damages in dollar value are estimated conservatively between $150 to $200 million annually.

The new chemical promises to save cattle breeders large sums of money in decreasing the damage to meat and hide and in milk production losses in cattle infected by this pest.

Ruelene is still undergoing field tests. The product will not be available on the market this season, according to Dow Chemical International Limited S.A. which plans to introduce the product on world markets.

More Pfizer Plants ?

A new Horticultural Society has been formed among members of Pfizer Ltd., the Kent manufacturing chemists.

Chairman and Secretary is E. H. Jordan the company's Head Gardener. Treasurer is Miss S. E. Kightly.

The society is affiliated to the Kent Federation of Horticultural Societies and will organise its own annual shows.

Members of the committee are: Mrs. F. R. Brown, Mrs. D. Tobin, E. W. Gibbens, A. Ashton, A. Brenchley and P. Sayers.

Swine Fever Restrictions extended to Cheshire

From 5th October the restrictions on the movement and marketing of pigs already in force in the central and southern parts of Lancashire are being extended to the whole of Cheshire. Swine fever has been troublesome in this county throughout the year, and particularly during recent weeks. According to past experience these restrictions should result in a marked reduction in the number of outbreaks of the disease.

Post Graduate Studentship Awards

The Ministry of Agriculture, Fisheries and Food has awarded the following post-graduate studentships in agricultural science. They are tenable in the first instance at the university or institute shown below for periods of up to two years normally from 1st October, 1959.

M. W. Catt, Linby, Notts.	Infestation Control Division, Ministry of Agriculture, Fisheries and Food.
M. J. Crutchley, Christchurch, Hants.	Oxford University.
B. E. Davies, Llandovery, Carms.	University College of North Wales, Bangor.
J. K. Gaunt, North Wembley, Middlesex.	University College of North Wales, Bangor
Miss M. P. Grant, Leverton, Boston, Lincs.	University of Edinburgh.
R. Howell, Crickhowell, Breconshire.	University College of North Wales, Bangor.
C. F. Jenner, Pembury, Kent.	Oxford University.
J. M. Palmer, Yeovil, Somerset.	Oxford University.
D. L. Rowell, Evington, Leicester.	Oxford University.
J. A. T. Saul, Hertford, Herts.	Nottingham University.
C. H. Walker, Worthing, Sussex.	Aberdeen University.
S. B. Wilson, Loughborough, Leics.	Nottingham University.
T. G. Wood, Burnley, Lancs.	Nottingham University.

Industrial Pest Control Association

At a meeting of the above Association to be held at the Hotel Rembrant, South Kensington, London, S.W.7, on Tuesday, 20th October, 1959, a lecture entitled "Reminiscences of an American Trip" will be given by Mr. S. W. Hedgcock of Disinfestation Ltd.

Association of Applied Biologists

A general Meeting of the Association will be held in the Meeting Room of the Zoological Society of London, Regents Park, London, N.W.1, at 10-50 a.m. on Friday, 23rd October, 1959.

After the formal business of the meeting there will be a Symposium on: **Control of Harmful Birds.**

The Speakers will be: Mr. H. V. Thompson (*M.A.F.F., Tolworth*), on "Economic Ornithology;" Dr. C. J. Duncan (*Department of Zoology, University of Liverpool*), on "The Sense of Taste in Birds;" Mr. R. J. P. Thearle (*M.A.F.F., Tolworth*) on "The Use of Narcotics in Catching Harmful Birds;" Mr. E. N. Wright and Mr. D. D. B. Summers (*M.A.F.F., Tolworth*) on "Biology of the Bullfinch and its Economic Importance" and, Mr. R. K. Murton (*M.A.F.F., Tolworth*) on "The Population Dynamics of the Wood-Pigeon and Methods of Control."

The Fertilizer Society

The next meeting of the Society will be held on Thursday, 22nd October, 1959 at 2-30 p.m. in the lecture hall of the Geological Society, Burlington House, Piccadilly, London, W.1, when there will be presented a paper entitled "Soil analysis and Fertilizer Recommendation," by A. M. Smith, Ph.D., F.R.I.C. The paper will be followed by a discussion.

NEWS and PUBLICATIONS

Anti-Locust Experiments at Sunbury

To find the best type of solvent base for an anti-locust spray, experiments on a large number of locusts are at present being carried out at BP's Research Centre at Sunbury.

This is the first time locusts have been used for experiments at Sunbury, although the effect on flies of various petroleum based insecticides has been studied for some years. The present experiments are expected to last about six months and are being carried out on the African migratory type of locust, which is being bred at the Research Centre.

It is hoped that these studies will result in the production from BP's Grangemouth Refinery of an improved type of solvent with which the insecticide component can be mixed. This mixture will then be sprayed on locust swarms and breeding grounds.

Agricultural Improvement Council for England and Wales

The Agricultural Improvement Council for England and Wales, whose members recently completed a further three-year term of office, has now been reconstituted by the Minister of Agriculture, Fisheries and Food.

The membership of the reconstituted Council is:

Sir John Winnifrith, K.C.B. (*Chairman*), Permanent Secretary, Ministry of Agriculture, Fisheries and Food.
Sir Frank, Engledow C.M.G., M.A., B.Sc., F.R.S. (*Vice-Chairman*), Emeritus Drapers' Professor of Agriculture, Cambridge University.
Captain J. F. Bomford, M.C., Farmer and Market Gardener, Spring Hill, Pershore, Worcestershire.
Harold Collison, Esq., General Secretary, National Union of Agricultural Workers.
John Edgar, Esq., Farmer, Walkford Farm, New Milton, Hampshire.
Professor Sir Joseph B. Hutchinson, C.M.G., Sc.D., F.R.S., Drapers' Professor of Agriculture, Cambridge University.
K. W. T. Jones, Esq., Farmer, Sennybridge, Brecon.
Professor K. Mather, C.B.E., D.Sc., Ph.D., F.R.S., Professor of Genetics Birmingham University.
J. W. S. Mount, Esq., Horticulturist and Farmer, Little Barton Farm, Canterbury, Kent.
The Lord Netherthorpe, B.Sc., Ll.D., President, National Farmers' Union.
His Grace the Duke of Northumberland, K.G., Landowner and Farmer, and Chairman of the Agricultural Research Council.
H. J. Rathbone, Esq., O.B.E., F.L.A.S., Chartered Land Agent, Surveyor and Valuer, Mold, Flintshire.
F. Rayns, Esq., C.B.E., M.A., Director, Norfolk Agricultural Station, Sprowston, Norwich.
Sir William Slater, K.B.E., D.Sc., F.R.I.C., F.R.S., Secretary, Agricultural Research Council.
Professor P. T. Thomas, B.Sc., Ph.D., Professor of Agricultural Botany, University College of Wales, Aberystwyth and Director, Welsh Plant Breeding Station.
C. Thornber, Esq., Poultry Breeder, Mytholmroyd, Halifax, Yorkshire.
Professor T. Wallace, C.B.E., M.C., D.Sc., F.R.I.C., F.R.S., V.M.H., Former Director, Long Ashton Fruit and Cider Research Station, Bristol.
Professor E. G. White, D.Sc., Ph.D., F.R.C.V.S., Professor of Veterinary Preventive Medicine, Liverpool University.
W. Morley Davies, Esq., M.A., B.Sc., F.R.I.C. (*Secretary*), Senior Education and Advisory Officer, Ministry of Agriculture, Fisheries and Food, Great Westminster House, Horseferry Road, London, S.W.1.

Agricultural Chemicals, September 1959.

Published by Industry Publications Inc., Baltimore.

As this is an American pulbication the speciai feature of this issue which is the 1959-60 Buyers' Guide will mainly be of interest to readers in that country. There are, however, several articles which will be of general interest including " The Relative Toxicity to Mammals of 40 Pesticides " and the discussion of the results obtained with several new pesticides in orchards. A review of " Readers Digest " pesticide articles is also included following the recent criticism of the article " Backfire in the War Against Ants " which appeared in the June edition of the " Readers Digest." The article " Spray Characteristics of Co-Ral " may be of particular interest to readers in Great Britain as this cattle grub systemic may shortly be released in this country.

Information Leaflets in French

Technical Information Leaflets printed in French and entitled" Pesticides S.D.C. pour la protection du Bois," have been made available by the Standardised Disinfectants Company Limited. The leaflet describes S.D.C's products " Hexastan L.P.", " Protostan " and " Protoseal " for the protection of logs and lumber from attack and damage by insects and fungi during production.

Recommended Common Names for Pesticides

Supplement No. 1 to British Standard 1831: 1957 contains 12 additional Recommended Common Names, having been approved by the Pest Control Products Industry Standards Committee and endorsed by the Chairman of the Chemical Divisional Council, were published under the authority of the General Council on 31st August, 1959. The Supplement can be obtained from: British Standards Institution, British Standards House, 2, Park Street, London, W.1.

California Agriculture, September, 1959.

Published by the Division of Agricultural Sciences, University of California.

The September issue of "California Agriculture" is devoted entirely to articles on nematodes. The articles include: " Nematode Structure and Life," " Nematodes in Grape Production," nematodes in " Field and Vegetable Crops," " Natural Enemies of Nematodes," " Chemical Control of Nematodes " and others. All told it is an excellent issue.

BOTRYTIS CONTROL

BOTRYTIS CINEREA or Grey Mould, is an air and soil-borne fungus that attacks winter lettuce under glass.

The attacks may occur at any stage from seedling to mature plant and the primary infection often emanates from dead material, either in the soil, or under the collar of the lettuce.

The fungus spreads rapidly through the healthy tissue of the lettuce, the plant begins to wilt and a soft rot of the heart sets in.

It is one of the problems of the disease that despite good anti-botrytis husbandry—e.g. the use of clean or sterilised soil, not too dense sowing, care not to damage in transplanting, immediate rogueing of any diseased plants, good ventilation—conditions may yet make an attack inevitable. In particular the key preventive factor of adequate ventilation to keep down humidity becomes impossible when wet foggy conditions persist outside.

A bad attack can render the bulk of the crop unmarketable. But the disease also causes losses in its sub-lethal form. When it is perhaps not sufficiently acute to destroy a large part of the crop, the presence of some degree of infection at the base and heart of the plants may still render them unmarketable, or at least necessitate trimming them down in size with consequent loss of grade and price.

Very full protection is now provided at all stages by the new product, Allisan—the active component of which is a nitrated chloro-aniline derivative—against the lethal and sub-lethal forms of the disease. No check is caused to the plant. The phyto-toxicity of the product has been tested across a wide range of lettuce varieties, using quantities greatly in excess of recommended field rates and no check has been produced when used excessively either for pre or post planting.

Economic Considerations

Extensive surveys made during the commercial trials demonstrated that, very often, in crops regarded as clear of botrytis, losses from this disease might still amount to as much as five to six per cent.

This is in crops regarded as clean. Where unfavourable conditions trigger off an attack, the losses may vary from 40-60 per cent or more of the entire planting.

Allisan costs 22/-, to treat 100 square yards of lettuce bed. Assuming an average return to the grower of 5d. per lettuce, the cost of control works out at roughly 2 per cent of a crop. Put another way, if a crop with a potential loss of 2 per cent from botrytis can be raised to 100 per cent, that more than covers the cost. This is on a straight cash for cash basis and ignores the main object which is insurance against the possibility of a major attack, which can be disastrous.

Routine usage also cuts down the losses from the sub-lethal effects of the disease which often necessitate trimming and can greatly increase the cost of packing for market.

In the course of the extensive tests and trials, the ability of Allisan to control botrytis and yet *cause no check to the growth of the plant* was confirmed as a major new economic factor in the control of the disease. On average the size of the lettuces treated with Allisan was 1½ times the size of those treated with tetrachloronitrobenzene, a compound which gave approximately equal control but caused considerable check to the crops.

Recommendations

The extensive trials conducted in the field with commercial growers have been concerned mainly with three types of crop.

1. those planted between September and October for Christmas use, which are normally given some heat and mature in 10-12 weeks.
2. those planted in October/November in cold houses, and which mature in March/April.
3. those planted in January and February and which constitute the majority of the lettuces grown.

The following recommendations ensure maximum control of the disease and the absence of any significant residues:

For *Seed Beds*, ½ to 1 oz. per square yard is applied before raking the seed. This gives a higher percentage of germination and protects the seedlings at an early stage.

For *Soil for Boxes* for transplanted seedlings or soil used for *Block making*, 1½ ozs. is mixed to each bushel of soil (2 lbs. per cubic yard).

For *Seedlings in Bed, Boxes or Soil Blocks*, to prevent early infection with botrytis the seedlings are dusted after the first true leaves are formed with ¼ oz. per square yard, and this is repeated at monthly intervals until planting out.

For plants in *Frame Crops* other than those raised in soil blocks, 1 oz. per square yard is applied to the bed before planting. For plants in soil blocks the dressing is ¼ oz. per square yard directly after planting.

For *Crops in Houses* the bed is treated with 1 oz. per square yard before planting. No further treatment will be required if the crop is to be cut within 12 weeks of planting. Where the crops are growing for longer periods a further dusting of ¼ oz. per square yard is applied when the plants are half-grown. When plants in treated soil blocks are used, the pre-planting application is omitted and the dust is applied directly after planting at ¼ oz. per square yard, repeated when the plants are half-grown.

Where the plants are raised in soil blocks, the Allisan must be mixed with the soil used in making the blocks.

It is recommended that Allisan should not be used on emerging seedlings until the first two true leaves are formed, nor on wilting plants. To avoid the possibility of excessive residues, applications should not be made, post-planting, on Christmas crop lettuce. Later maturing lettuce should not be dusted within 20 days of cutting.

For the control of " Fire " on tulips under glass, Allisan is applied as a fog at the rate of ⅛ oz. per square yard.

For the control of Botrytis Stem Rot of Tomatoes a thick paste is prepared by adding water to Allisan and applying it to the affected areas.

Allisan is manufactured by Boots Pure Drug Co. Ltd.